

Over a three day period (Feb 10-12, 2007), we set out on a series of dives of increasing length aimed at establishing our swim times and gas usage for various legs between Orange Grove, Challenge, Olsen and Peacock I, with the eventual aim of swimming the Grand Traverse from Orange Grove to Peacock and back (a total of 9200 ft; note the circuit with the return route going from Peacock directly to Challenge via the Peanut Restriction would be 9000 ft). While we did not manage to carry out the return traverse owing to time limitations, we did establish that both of us could maintain an average SAC rate of about 0.65 cuft/atm/min, a swim rate of ~60ft/min, and complete the full dive with two A180 stages and a full set of double 104s for backgas, while ending the dive with slightly more than a 1/3rd of our total initial gas remaining.

One of the first things we realized right away is that the linear relationship between gas volume and psi above 3000 psi is no longer linear. For example, if one starts off with 3600 psi in double 104s and ends up with 2800 psi at the end of the dive, the amount of gas actually consumed is 50 cuft, while the linear approximation ( $800 \times 7.87 / 100$ ) would give 63 cuft. This is not insignificant since it corresponds to a 26% difference in gas usage and hence calculated SAC rate (e.g. a respectable SAC rate of 0.65 would appear as a rather poor SAC rate of 0.82 using the linear approximation). For calculation of 1/3rds, however, one should still divide the initial psi in the tank by 3, since this provides one with an additional safety factor. Thus, for example, in double 104s, with an initial starting pressure of 3600 psi, the turn pressure would still be 2400 psi, which actually corresponds to 79 cuft, but the volume of gas for the return journey is 94 cuft (2400 psi to 1200 psi) with 94 cuft left in the tanks at the end of the dive. (However, if one considers a 200 psi reserve, then the remaining 94 cuft actually translates to a usable 79cuft).

**Table 1.** Volume of gas as a function of PSI above 2600 psi for steel double 104s and 95s, and for Luxfer A180 stage bottle.

PSI	double 104s		double 95s		Alu 80 stage	
	actual	linear	actual	linear	actual	linear
2600	205	205	187	187	67	67
2700	212	213	194	194	70	70
2800	219	221	200	202	72	72
2900	226	229	207	209	74	75
3000	233	236	213	216	77	77
3100	239	244	219	223	79	80
3200	246	252	225	230	81	83
3300	252	260	231	238	83	85
3400	258	268	236	245	85	88
3500	264	276	241	252	87	90
3600	269	284	247	259	89	93
3700	274	292	251	266	-	-

<sup>a</sup>Actual: calculated from a polynomial fit to the actual volumes at 2640, 3000 and 3440 psi listed for Worthington X8-130 (equivalent to 104) and X8-119 (equivalent to 95) cylinders (see <http://www.diveriteexpress.com>)

<sup>b</sup>Linear: for double 104s, cuft gas =  $\text{psi} \times 7.87 / 100$ ; for double 95s, cuft gas =  $\text{psi} \times 7.2 / 100$ ; for A180, cuft gas =  $\text{psi} \times 2.58 / 100$ .

**Day 1 (Feb 10, 2007): Total distance swum 6600 ft.**

*Dives 1 and 2:* The first two dives involved the circuit from Peacock to Olsen via the Peanut Tunnel and Peanut Restriction (Dive 1; 2400 ft) and from Olsen back to Peacock via Pothole (Dive 2; 1400 ft). The distance from Peacock to the jump from the Peanut restriction to the Olsen Line is 1800 ft and took 33 min (swim rate of 55 ft/min) including placing the primary line to connect open water to both main lines at the entrance of Peacock; we spent 3 min setting up the jump to the Olsen line, and 14 minutes to swim the 600 ft to Olsen sink, including the time taken to lay a line from the Challenge to Peacock side of Olsen sink. The total dive time was 50 minutes with a maximum depth of 54 ft. Total gas usage, breathing only from our stage bottle was 72 cuft for Marius and 70 cuft for Larry. After a 15 min surface interval at Olsen, we proceeded to swim the 1400ft back to Peacock via Pothole (66 ft maximum depth) in 21 min (swim rate of 67 ft/min), each of us consuming 50 cuft of backgas.

*Summary of dives 1 and 2:* Total swim distance for circuit: 3800 ft. Total swim time: 71 min. Total gas used for circuit: 122 cuft for Marius and 120 cuft for Larry.

*Dives 3 and 4:* Dives 3 and 4 consisted of a simple swim with no stages from Peacock to Olsen via Pothole and back, with a 15 min surface interval at Olsen (max depth, 66 ft; average depth, 47 ft). Each leg was swum in 22 minutes (swim rate of 64 ft/min). For the

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outbound leg, total gas usage was 28 cuft for Marius and 35 cuft for Larry; for the return leg, the corresponding gas usage was 50 cuft and 51 cuft, respectively. Given that our gas usage for the Olsen to Peacock swim via Pothole was consistently around 50 cuft (cf Dive 2), and that our swim rate was consistently between 64-67 ft/min, one can only conclude that we must have been swimming against a slight flow on the Olsen to Peacock leg.

*Summary of dives 3 and 4:* Total swim distance: 2800 ft. Total swim time: 44 min. Total gas used: 78 cuft for Marius and 85 cuft for Larry.

***Day 2 (Feb 11, 2007): Total distance swum 8300 ft***

*Dives 5, 6 and 7:* The first three dives involved the circuit from Peacock to Challenge via the Peanut tunnel and Peanut restriction (Dive 5; 2600 ft); the return from Challenge to Olsen (Dive 6; 1400 ft); and the final leg from Olsen to Peacock via Pothole (Dive 7, 1400 ft). Both of us carried a single stage. The swim from Peacock to the Peanut Restriction Olsen jump took 30 minutes (1800 ft, swim rate 60 ft/min), followed by 11 minutes for the 800 ft from the jump to Challenge (swim rate 73 ft/min). The total duration of the dive was 41 min with a maximum depth of 54 ft. Total gas usage, breathing only from our stage bottle was 60 cuft for Marius and 53 cuft for Larry. After a 17 min surface interval we embarked on the second leg from Challenge to Olsen (1400 ft; 63 ft maximum depth). This took 27 min (swim rate of 52 ft/min) but included the time for removal of the jump from the Peanut Restriction to the Olsen line which was carried out in a two step procedure in which one of us installed a temporary jump from Olsen to the Peanut Restriction, the other removed the existing jump from the Peanut Restriction to the Olsen line installed the previous day, and finally the temporary jump was removed. This probably took around 3 min. Gas usage (from backgas) for the second dive was 45 cuft for Marius and 39 cuft for Larry. After a 10 min surface interval at Olsen, we embarked on the final leg from Olsen to Peacock via Pothole. Consistent with our dives on the 1st day, this leg took 21 min to complete (swim rate 67 ft/min) with Marius and Larry consuming 47 and 55 cuft of backgas, respectively.

*Summary of dives 5, 6 and 7:* Total swim distance for circuit: 5400 ft. Total swim time for circuit: 89 min. Total gas used for circuit: 152 cuft for Marius, 147 cuft for Larry.

*Dives 8 and 9:* Dives 8 and 9 were a repeat of dives 3 and 4 from Day 1 (i.e. Peacock to Olsen via Pothole and back). Again we took 21 min to complete each leg (swim rate 67ft/min). In the outbound leg, gas usage was 35 cuft for Marius and 31 cuft for Larry; for the return leg gas usage was 40 cuft for Marius and 39 cuft for Larry.

*Summary of Dives 8 and 9:* Total swim distance: 2800 ft. Total swim time: 42 min. Total gas used: 75 cuft for Marius and 70 cuft for Larry.

***Day 3 (Feb 12, 2007): The Grand Traverse Orange Grove to Peacock (4600 ft).***

As noted above, our intention was to swim the Grand Traverse from Orange Grove to Peacock and back for a total of 9200 ft, but we aborted after completing the outbound journey, although we had enough remaining gas to complete the return leg on 1/3rd of our initial gas supply. We started out carrying two stages (2 Al80s for Marius and 2 Al72s for Larry) with fully filled 104s for backgas (~3600 psi). Total initial gas supply was 435 cuft and 415 cuft for Marius and Larry, respectively, with 138 cuft (1/3rds) usable for the traverse. Dive 10 from Orange Grove to Challenge (1800 ft; max depth 66 ft; average depth, 47 ft) was completed in 36 min (swim rate 50 ft/min) and included the time to lay the primary reel. We each breathed off a single stage and consumed 57 cuft (Marius) and 58 cuft (Larry). After 15 min surface interval we swam the 1400 ft Challenge to Olsen leg (Dive 11) in 23 min (swim rate of 61 ft/min), breathing off our second stage (39 cuft for Marius and 38 cuft for Larry). Thus, our swimming rate and gas consumption for this leg was consistent with that on Day 2. After a 15 min surface interval at Olsen, we completed the final 1400 ft leg from Olsen to Peacock via Pothole (Dive 12) in 23 min (swim rate 61 ft/min), each of us breathing 39 cuft from our second stage. No backgas was breathed during the entire dive, but ~6 cuft of backgas was consumed for the wing and drysuit (leaving 3500 psi, corresponding to 264 cuft available in backgas). Larry had 400 psi left in one of his Al72 stages and breathed the other one empty; Marius had 1200 psi left in one of his Al80 stages and 200 psi in the other. The total swim time for the 4600 ft traverse was 82 min (average swim rate of 59 ft/min) and each of us consumed 135 cuft of gas, corresponding to an average SAC rate of ~0.65 cuft/atm/min.

*Summary of Dives 10, 11 and 12:* total swim distance for traverse: 4600 ft; total swim time: 82 min; total gas used (stages only): 135 cuft for Marius and 135 cuft for Larry.

***Overall statistics over 12 dives on three successive days in the Peacock System:***

Date: Feb 10-12, 2007

Water level: water was right at the bottom of the first riser of the steps at Peacock I

Total distance swum: 19,400ft



Average swim speed:  $61.0 \pm 6.4$  ft/min

Average overall gas consumption: Marius:  $2.93 \pm 0.49$  cuft/100ft of swimming; Larry:  $2.93 \pm 0.57$  cuft/100 ft of swimming. (Note that these gas consumption rates are derived from the total duration of the dives).

Marius Clore: 51 years, 145 lbs, 5' 7", good physical condition, wearing a DUI TLS350 drysuit (stock size small).

Larry Green: 57 years, 180 lbs, 5' 11", good physical condition, wearing a DUI TLS350 drysuit (oversized stock size large).

It is worth noting that although our average overall gas consumption was very evenly matched, there is quite a bit of variation depending on flow (and even a very small amount of flow that is barely, if at all, noticeable, can impact one's gas consumption significantly) and physical state (i.e. how tired one is). In addition, although the distance markers from Challenge to Olsen and Olsen to Peacock indicate that both legs are 1400 ft, our swim times for the former leg (average  $\sim 25 \pm 2$  min) were consistently longer than the latter (average  $\sim 22 \pm 1$  min), suggesting that the actual swim distance from Challenge to Olsen is a little longer (possibly around 1500 ft).

# 2007 NACD WORLD CAVE DIVING CONFERENCE AND SEMINAR

Sat, Nov 17th  
Gainesville, Florida

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